

REMARKS

Applicants are amending their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants are amending claim 11 to recite that the tip end of each of the micro pillars is kept in contact with a surface of an upper substrate constituting the flow path. Note, for example, Fig. 4i of Applicants' original disclosure, together with the description in connection therewith in the paragraph bridging pages 21 and 22 of Applicants' specification, as well as Figs. 7 and 8 and the description in connection therewith on pages 31-35 of Applicants' specification. In this regard, note that for the micro biochip to constitute a "molecular filter", the tip end of each of the micro pillars would be kept in contact with a surface of an upper substrate.

Applicants have amended claim 16 to be dependent on claim 27, and to recite the step of bringing a second matrix, constituting the upper substrate, in contact with the tip end of each of the group of columnar micro pillars through the spacer and fixing it thereon.

In addition, Applicants have amended method claim 27 to recite a method for manufacturing a micro biochip having a functioning substrate, and to recite step of placing an upper substrate on the group of columnar micro pillars to thereby bring a tip end of each of the columnar micro pillars into contact with the upper substrate to form a flow path between the functioning substrate and the upper substrate. Note the previous discussion herein as to why, in forming the molecular filter, a tip end of each of the columnar micro pillars would be brought into contact with the upper substrate to form a flow path between the functioning substrate and the upper substrate.

Moreover, Applicants are adding new claims 32-34 to the application. Claim 32, dependent on claim 11, recites that the micro biochip further includes an

upper substrate, with the tip end of each of the micro pillars being kept in contact with the surface of the upper substrate constituting the flow path. Claims 33 and 34 are product-by-process claims, dependent respectively on claims 27 and 16.

It is respectfully submitted that claims 32-34 are directed to the elected invention, and are to be considered on the merits in the above-identified application.

Applicants respectfully submit that the claims being considered on the merits in the above-identified application patentably distinguish over the teachings of the reference applied by the Examiner in rejecting claims in the Office Action mailed May 30, 2008, that is, the teachings of U.S. Patent No. 7,195,872 to Agrawal, et al., under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that the reference as applied by the Examiner would have neither taught nor would have suggested such a micro biochip as in the present claims, including, inter alia, wherein an aspect ratio of a micro pillar of the micro pillar group of the micro biochip is 4 or more, wherein a plurality of micro pillar groups of organic polymer are provided in a flow path for feeding a sample, and the tip end of each of the micro pillars is kept in contact with a surface of upper substrate constituting the flow path. Note claim 11. Note also claim 32, reciting that the micro biochip further comprises the upper substrate.

As for advantages of the presently claimed structure, see, e.g., the paragraph bridging pages 31 and 32, and the paragraph bridging pages 32 and 33, of Applicants' specification. Note also the first full paragraph on page 33 of Applicants' specification, describing that by utilizing the upper substrate 1001 (see Fig. 8 of Applicants' disclosure) and allowing the substrate to come in close contact with the micro pillar group 1000, this configuration prevents the sample from leaking through the gap between the micro pillar group 1000 and upper substrate 1001, thereby ensuring a highly sensitive analysis.

In addition, it is respectfully submitted that the teachings of the applied reference would have neither disclosed nor would have suggested such a micro biochip as in the present claims, having features as discussed previously in connection with claim 11, and further including, inter alia, features as in claims dependent on claim 11, such as (but not limited to) wherein the organic polymer is modified on the surface of the micro pillars (see claim 12); and/or wherein the organic polymer contains at least one of antigen, sugar chain and bases (see claim 13); and/or wherein the micro pillar group is a group of micro pillars formed by pressing a mold, having pits, against the material such that the material is pressed into the pits, and separating the mold therefrom, thereby to elongate the columnar micro pillars from the matrix surface (see claim 28), particularly wherein the organic polymer is modified on the surface of the micro pillars (see claim 29); and/or wherein the material of the group of micro pillars includes such an organic polymer that elongates when the mold, having the material of the group of micro pillars therein, is separated therefrom (see claims 30 and 31).

Moreover, the teachings of the applied reference would have neither taught nor would have suggested the micro biochip formed by the process of claim 27, including wherein an upper substrate is placed on the group of micro pillars to thereby bring a tip end of each of the micro pillars into contact with the upper substrate (see claim 33); or the micro biochip formed by the process of claim 16 (see claim 34).

The invention being considered on the merits in the above-identified application is directed to a micro biochip, being equipped with micro pillar groups.

As described on pages 1-3 of Applicants' specification, various types of nano-pillar structure have been proposed, formed by various techniques. For example, a nano-silicon pillar group using a metallic cluster such as iron, gold and silver as a

self-forming nucleus of a plasma etching mask has been proposed. Another technique forms resin-made micro pillars, in which the surface of a silicon substrate is coated with a polymethyl methacrylate film; a mask of a silicon substrate is placed on the film through a spacer; and then heating is performed, in order to form micro pillars on the polymethyl methacrylate film.

However, previously proposed structures involved certain problems. For example, formation of the nano-pillars as described in the foregoing is restricted to inorganic materials, and requires a dry etching method. Moreover, in forming the polymethyl methacrylate micro pillars, it has been difficult to control the position, the diameter and height of the micro pillars freely.

Against this background, Applicants provide structure that can easily and effectively be provided, and which can provide accurate and precise micro pillars made of plastic material and incorporates such micro pillars in a micro biochip to ensure highly sensitive analysis using such micro biochip. Applicants have found that by forming the pillars of thermoplastic polymer material, the pillars having specified dimensions including an aspect ratio of at least 4, the micro pillars being provided in a flow path (for feeding a sample), the tip end of each of the micro pillars being kept in contact with an upper substrate constituting the flow path, objectives of the present invention are achieved. That is, the sample is prevented from leaking through a gap between the micro pillar group 1000 and upper substrate 1001, ensuring highly sensitive analysis. See page 33, lines 7-16, of Applicants' specification.

In addition, the micro biochip can act as a molecular filter, as described in the last full paragraph on page 31, and the paragraph bridging pages 31 and 32, of Applicants' specification.

Moreover, the micro pillars can be formed with high aspect ratio and high

precision, and can be made of thermoplastic polymer material, thus forming a structure which is relatively inexpensive and which can be formed by an easy and relatively inexpensive method.

Agrawal, et al. discloses a substrate having a high surface area for use as a microarray device, wherein structural micro features are formed on a surface of a substrate that increases surface area and accessibility thereto. The described substrate includes a plurality of adjacent microfeatures on a surface of a substrate arranged in spatially discrete regions to provide a texture on the surface, the textured surface providing an increase in surface area as compared to a non-textured surface. This patent discloses the substrate may include a material selected from the group consisting of glass, a ceramic, a metal, a non-metal and a polymer; and that the microfeatures may include a material that is different from the material of the substrate, this material being selected from a group consisting of glass, a ceramic, a metal, a non-metal, an inorganic oxide and a polymer. This patent discloses that a plurality of microfeatures may include a pit, a trench, a pillar, a cone, a wall, a micro-rod, a tube, a channel or a combination thereof. Note column 4, lines 41-58. See also column 4, lines 63-67, describing aspect ratios of the microfeatures, among other aspects thereof. In column 5, lines 12-18, this patent discloses that the surface further includes a plurality of microstructures, which may comprise a pit, a trench, a pillar, a cone, a wall, a micro-rod, a tube, a channel or a combination thereof. As to what is meant by "microfeatures" and "microstructures", note column 11, lines 19-36 of Agrawal, et al. See also column 6, lines 46-54; and from column 6, line 60 through column 7, line 3. See also column 15, lines 12-18 and 53-57; and column 16, lines 56-60. Note, further, column 17, lines 7-14, 24, 25 and 43-46.

Attention is respectfully directed to Example 13 in column 54 of Agrawal, et al., and Fig. 9 in connection therewith. That is, Fig. 9 illustrates a reaction vessel

that comprises contacting textured surfaces of the substrates, two substrates 901, 902 being placed such that the textured surface of substrate 901 is facing the textured surface of substrate 902. This patent further discloses that a well of substrate 901 is placed directly opposite the micro feature of substrate 902; and that in embodiments that involve hybridization, hybridization fluid is placed in the space between the two substrates, and during hybridization one of the two substrates is laterally oscillated, thereby creating a turbulent flow which promotes efficient mixing and, thus, a high degree of hybridization and a reduction in hybridization time. Note particularly column 54, lines 17-31, of Agrawal, et al., together with Fig. 9 thereof.

As seen especially in Fig. 9 of Agrawal, et al., this patent would have neither disclosed nor would have suggested such structure as in the present claims, including wherein the tip end of each of the micro pillars is kept in contact with an upper substrate constituting the flow path, much less the plurality of micro pillar groups of organic polymer being provided in the flow path, especially together with dimensions of the micro pillars, including aspect ratio thereof, and advantages thereof as discussed previously.

In the last three lines of the first paragraph on page 3 of the Office Action mailed May 30, 2008, in discussing the teachings of Agrawal, et al., the Examiner refers to the two substrates 901, 902 being sandwiched, the Examiner referring to Example 13 of Agrawal, et al. However, it must be emphasized that claim 11 recites that the tip end of each of the micro pillars is kept in contact with an upper substrate constituting the flow path. It is respectfully submitted that such structure as in claim 11 would have neither been taught nor would have been suggested by the disclosure of Agrawal, et al., even as shown in Fig. 9 wherein tip ends of the micro pillars do not contact, e.g., micro pillars of the opposing substrate.

In addition, it is emphasized that Agrawal, et al., in the embodiment of Fig. 9,

provides the substrates 901, 902 to promote turbulent flow which promotes efficient mixing. It is respectfully submitted that such disclosure as in Agrawal, et al. does not teach, nor would have suggested, the plurality of micro pillar groups being provided in a flow path, much less that the tip end of each of the micro pillars is kept in contact with an upper substrate constituting the flow path, and advantages thereof as in the present invention.

As acknowledged by the Examiner on page 4 of the Office Action mailed May 30, 2008, Fig. 9 of Agrawal, et al. "supports [Applicants'] argument"; however, the Examiner contends that the argument "is not persuasive because Example 13 of the reference comprises two substrates sandwiched together wherein the textured surfaces of the substrates contact one another", the Examiner referring to column 54, lines 16-19, of Agrawal, et al. Column 54, lines 16-20, of Agrawal, et al. sets forth that Fig. 9 illustrates a reaction vessel that comprises contacting textured surfaces; it is respectfully submitted that such disclosure in Agrawal, et al. would have neither taught nor would have suggested the presently claimed micro biochip, wherein the tip end of each of the micro pillars is kept in contact with a surface of an upper substrate constituting the flow path.

It is emphasized that the top face of a leg portion of the micro features 801 in Agrawal, et al. (note Fig. 8 thereof) is higher than the tip ends of other micro features; accordingly, it is respectfully submitted that the tip ends of the micro features other than leg portions 801 do not touch each other. It is respectfully submitted that Agrawal, et al. would have neither taught nor would have suggested such feature of the present invention wherein the tip ends of each of the micro features contact the surface of the upper substrates.

It is respectfully submitted that in Agrawal, et al., the micro features do not constitute small, independent micro cells between the substrates. That is, Agrawal,

et al. does not intend to provide a micro biochip having micro cells defined by micro pillars or micro features. In contrast, according to the present invention, microbial samples can flow through the micro cells to thereby filter the samples according to their molecules. It is respectfully submitted that this concept would have neither been disclosed nor suggested by Agrawal, et al. Thus, it is respectfully submitted that Agrawal, et al. would have neither taught nor would have suggested the presently claimed structure, or functions and advantages achieved thereby.

It is emphasized that according to the present invention, by providing the tip end of each of the micro pillars in contact with an upper surface constituting the flow path, the sample is prevented from leaking through the gap between the micro pillar group 1000 and upper substrate 1001, thereby ensuring highly sensitive analysis; and also the micro biochip can act as a filter. In contrast, Agrawal, et al. discloses the structure of the embodiment in Fig. 9 using two substrates, to increase throughput and eliminate the need for a cover slide. See column 54, lines 30 and 31, of Agrawal, et al. It is respectfully submitted that Agrawal, et al. would have neither disclosed nor would have suggested the structure of the micro biochip of the present claims, and advantages thereof.

Again, it is emphasized that according to the present invention, including wherein the tip end of each of the micro pillars is in contact with the surface of the upper substrate, as in the present claims, a filtering action is achieved by the present invention. This filtering would have neither been disclosed or suggested, or achieved, by the structure of Agrawal, et al., even were the compartment walls 801 (note column 52, lines 55-67, of Agrawal, et al.) defining a well to contact each other, with the pillars 802 not contacting each other as Agrawal, et al. discloses that the pillars 802 “have heights less than the heights of the compartment walls”. Note column 52, lines 62 and 63.

The Examiner's attention is also directed to claim 27, reciting a method for manufacturing a micro biochip. Claim 27 has been withdrawn from consideration, as being directed to a non-elected invention. It is respectfully submitted that upon allowance of claim 11, directed to the micro biochip, claim 27 and claims dependent thereon should be re-joined in the above-identified application and allowed to issue in a U.S. patent issuing therefrom, since if the micro biochip of claim 11, wherein each of the tip ends of micro pillars is in contact with the upper substrate, is patentable then the claimed method of production thereof in claim 27 (as well as claims dependent thereon, including claim 16) would also be patentable.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently being considered on the merits in the above-identified application, and rejoinder of the method claims and allowance of these method claims in the above-identified application, are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (No. 520.43241X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By /William I. Solomon/
William I. Solomon
Registration No. 28,565

WIS/ksh
1300 17th Street N., Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-12-6666